

The Nucleus and Elementary Particles

CHAPTER CONTENTS

Multi-Lab
Radioactive Decay 545

13.1 Structure of the Nucleus 546

13.2 Radioactivity and Nuclear Reactions 556

Investigation 13-A
Half-Life of a Radioactive Isotope 572

13.3 Elementary Particles 576

Investigation 13-B
The Wilson Cloud Chamber 578

Investigation 13-C
Measuring the Mass-to-Charge Ratio for Electrons 584

PREREQUISITE CONCEPTS AND SKILLS

- Electric force and Coulomb's law
- Equivalence of mass and energy
- Conservation of mass-energy
- Potential and kinetic energy



Twentieth-century physics was ruled to a large extent by a quest for ultra-high energies. It might seem strange that such energies are required in order to investigate the tiniest, most subtle particles of matter. However, probing inside the nucleus and then inside the particles of that nucleus requires instruments capable of accelerating electrons and protons into the mega-electron volt (10^6 eV) and giga-electron volt (10^9 eV) ranges of kinetic energy.

Such instruments, called “particle accelerators,” are located in university and government laboratories around the world. The above photograph shows an accelerator used at Conseil Européen pour la Recherche Nucléaire (CERN) located near Geneva, Switzerland. Along with other high-energy physics laboratories, CERN searches for new particles formed during energetic collisions between subatomic particles.

This chapter begins with the structure and properties of the nucleus and then examines the field of elementary particles, such as the ones created at CERN.